# Adsorption Of Copper Cu (2+) Metal Ion From Waste Water Using Sulphuric Acid Treated Sugarcane Bagasse as Adsorbent

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***ABSTRACT:***
*Removal of heavy metals from wastewater is a major ecological problem. Copper is highly toxic metal ion and considered as a priority pollutant released from various chemical industries like electroplating mixing activities, smelting, battery manufacture, etc. Adsorption process for the removal of heavy metal Cu (II) from synthetic wastewater by using low cost adsorbent (Sulphuric acid treated Sugar cane bagasse). It is cost effective method and also it do not cause the any type of environment pollution. Batch experiments of adsorption apply to wastewater on the adsorbent as decided concentration (5, 10, 15, 20 ppm), contact time (30, 60, 90,120 min), pH (2, 3, 4, 5), adsorbent doses (0.5, 1.0, 1.5, 2 gm) at room temperature. Maximum % removal of Cu (II) is obtained 94.4 % at pH 5, contact time 120 min, adsorbent dose of 2 gm for 5 ppm concentration. After pH 5 removal is decreased and also removal is decreased with increase in concentration.*

***Keywords:*** Adsorption, Sulphuric acid treated sugar bagasse, heavy metal (Cu+2), removal efficiency.

## I. INTRODUCTION

The tremendous increase in the use of heavy metals over the past few decades has resulted in an increased flux of metallic substances in the aqueous environment. The metals are of special concern because of their persistency. The study of pollution by toxic metal compounds assumes considerable importance in chemical process industries. In view of their high toxicity for human health, heavy metal concentrations in wastewater are restricted by strict standards. Copper is a persistent, bio-accumulative and toxic heavy metal which does not break down in the environment, it is not easily metabolized and can harm human health.

A variety of low-cost biomass has been investigated for controlling pollution from diverse sources in different parts of the world. These include an aerobically digested sludge, bacteria, fungi and algae. Agricultural materials have also been used. These include rice bran, soybean and cottonseed hulls, crop milling waste, groundnut husk, maize cob meal, coir, jute and sawdust, canola meal, and coconut shell. Copper is one such metal that requires considerable attention. Industrial wastewater from textile, leather tanning, electroplating, pigmentation and dyes contain copper in high concentration.

The application of low-cost adsorbents obtained from plant wastes as a replacement for costly conventional methods of removing heavy metal ions from wastewater has been reviewed. It is well known that cellulosic waste materials can be obtained and employed as cheap adsorbents and their performance to remove heavy metal ions can be affected upon chemical treatment.

Fly ash, Peanut hulls, Banana peels, Neem leaves, Tea waste, Sugar cane bagasse, Rise husk, Saw dust, Coconut husk, Soybean hulls, Cotton seed hulls are low cost adsorbents. [8]

**Table 1. Heavy metal removal efficiency (%) of different adsorbents**

| Adsorbent | Avg. Heavy metal removal efficiency (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cr(VI) | Ni(II) | Cu(II) | Zn(II) | Cd(II) | Hg(II) | Pb(II) |
| Rice husk carbon | 98.5 | 92.3 | 85.5 | 78.3 | 66.2 | 58.1 | 57.8 |
| Fly ash | 85.3 | 67.5 | 78.4 | 74.9 | 65 | 55 | 51 |
| Peanut hulls | 87.1 | 72.5 | 57.8 | 83 | 71.4 | 61 | 56.3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Banana peels | 91 | 81.3 | 81 | 73.8 | 62.8 | 70 | 61.8 |
| Neem leaves | 83 | 77.6 | 84.3 | 75.7 | 69 | 56.4 | 71.6 |
| Tea waste | 85.4 | 71.9 | 87.1 | 85.1 | 73.5 | 70 | 65.2 |
| Sugar cane bagasse | 99 | 87 | 94.2 | 75.3 | 71.5 | 61.7 | 66.5 |
| Saw dust | 84 | 75 | 91 | 57.8 | 59.7 | 62.7 | 55.8 |
| Coconut husk | 75 | 68 | 89.3 | 77.6 | 67.5 | 71.9 | 70 |
| Cotton seed hulls | 78 | 82 | 90 | 62.7 | 70 | 65.5 | 61 |

**Introduction & effect of Copper**

Copper is a persistent, bio-accumulative and toxic heavy metal which does not break down in the environment, it is not easily metabolized and can harm human health. The various potential sources of copper pollution are metallurgical and metal finishing, corrosion inhibitors in cooling and boiler systems, drilling mud's catalysts, primer paints, fungicides, copper plating and pickling, corrosion of copper piping, copper releases from vehicle brake pads.[7]

Acute poisoning from ingestion of excessive copper can cause temporary gastrointestinal distress with symptoms such as nausea, vomiting, and abdominal pain. Liver toxicity has been seen in doses high enough to cause death. High levels of exposure to copper can cause destruction of red blood cells, possibly resulting in anemia.

Mammals have efficient mechanisms to regulate copper stores such that they are generally protected from excess dietary copper levels. However, at high enough levels, chronic overexposure to copper can damage the liver and kidneys. Symptoms of liver toxicity (jaundice, swelling, pain) usually do not appear until adolescence [4].

## II. LITERATURE REVIEW

***Dr. P. Akhila Swathanthra, Dr. B. Sarath Babu, M. Srinivasa Rao, Dr.V.V.Basava*** Rao has studied that Adsorption behavior of copper from waste water has been investigated in this paper using Bagasse. Copper is highly toxic metal ion and considered as a priority pollutant released from various chemical industries like electroplating mixing activities, smelting, battery manufacture, etc. In the present paper, the experimental results carried out in batch adsorption process using treated Bagasse with synthetic samples prepared in laboratory were presented. The various parameters such as solution pH, initial copper concentration, Temperature and adsorbent dosage on the adsorption of Cu (II) were studied and presented. It was found that the adsorption data were fitted well by Langmuir isotherm. The Langmuir adsorption capacity was estimated at 4.75 mg/g for Bagasse. The maximum removal of Copper is above 93% was observed at pH of 5 for Bagasse in 100ppm Copper solution [1].

***N Prapurna and M Viswanatham*** has studied that the Adsorption Kinetics for the simultaneous and selective removal of Cr (VI) and Cu (II) ions from aqueous mixture was investigated using sugarcane bagasse. Batch studies were performed at room temperature at three different initial concentrations of each metal ion to be present in the test sample: 10ppm, 30ppm and 50ppm. The available literature for the removal of each of these heavy metal ions when present individually in aqueous solutions was applied in these studies. Accordingly, water washed and sun dried sugarcane bagasse retained on 200 micron-mesh, was used for the study at a dosage of 0.4 g/l of the test sample. The pH of the test samples varied from 7.05 initial values to 8.09 at equilibrium, during all the batch studies. The study has revealed that the adsorbent had higher selectivity to Cu (II) ions in comparison to the Cr (VI) ions at the study conditions. The experimental results fit well with linearized Freundlich Adsorption Isotherm Model [3].

***Patil Kishor P., Patil Vilas S., Nilesh Patil, Motiraya Vijay*** has investigated that the efficiency of removing copper ions and Zinc ions from Copper Chloride and Zinc Chloride, using naturally based adsorbents like Sugarcane Bagasse. Batch

adsorption studies show that the sugarcane bagasse has great ability for extracting metallic ions from wastewater samples. The factors affecting copper ion adsorption by sugarcane bagasse were determined to be initial concentration and pH of the solution, the results showed that bagasse were found to be an attractive low cost alternative for the treatment of wastewater. A good efficiency to remove toxic metal ions was achieved by usage of such by-product. The acid modified sugarcane bagasse and Cu (II) solution were kept in contact for various time periods 10, 20, 30, 60 min. The % removal of Cu was obtained 85-90%. Various time periods (1-4) hrs % removal is 60-70% [5].

***Thomas Anish Johnson, Niveta Jain, H C Joshi and Shiv Prasad*** studied that use of agricultural and agro-processing industry waste (Sugarcane bagasse) as metal adsorbents from wastewater. Modified materials displayed better adsorption capacity of some was comparable with that of commercial activated carbons and synthetic resins. Agricultural wastes are low cost adsorbents and can be viable alternatives to activated carbon for treatment of metal contaminated wastewater. Batch adsorption of sugarcane bagasse reached equilibrium by 60 min of contact and achieved 60% removal of Cu (II); a highest up to 30.9 mg/g for Cu (II) at pH 5.5 [7].

***Shaliza Ibrahim, Piarapakaran Subramaniam and Nasim Ahmad Khan*** has studied that the dsorption process is being widely used by various researchers for the removal of heavy metals from waste streams and activated carbon has been frequently used as an adsorbent. The objective of this study is to contribute in the search for less expensive adsorbents and their utilization possibilities for various agricultural waste by-products such as sugarcane bagasse, rice husk, oil palm shell, coconut shell, coconut husk etc. for the elimination of heavy metals from wastewater. At an adsorbent dose of 0.8 g / 50 ml is sufficient to remove 80 – 100% Cr (VI) from aqueous solution having an initial metal concentration of 20mg/l at a pH value of 1. The maximum removal obtained was around 99.8% at pH 2. The data for all the adsorbents fit well to the Freundlich isotherm [6].

## III. EXPERIMENTAL

**Preparation of Synthetic wastewater:** Take 5mg Copper metal powder in crucible then add 5 ml of concentrated nitric acid in to it. Then put in to burner and heat it till all brown fumes removed. The remaining blue solution in crucible will dilute in 1000 ml of distilled water.

**Preparation of Adsorbents**

The adsorbent was selected for removal of Copper by sugarcane bagasse. It is a waste product from sugar mill mainly composed of glucose, cellulose, pentose, and lignin. Adsorbent (Sugarcane bagasse) collected from Sugar industry. Firstly the adsorbent was washed with distilled water and dried at room temperature to avoid the release of color by adsorbent into the aqueous solution. The activation of adsorbent is carried out by treating it with concentrated sulphuric acid (0.1N) and is kept in an oven maintained at a temperature range of 150ºC for 24hr. Again is washed with distilled water to remove the free acid and put in to oven for removal of moisture and then adsorbent is passed from 500 micron mesh size and collected for experimental use.

Sugar bagasse before treatment

Hot air oven

Sulphuric acid treated Sugar bagasse

**Batch experiment**

The batch experiments are carried out in 250 ml borosil conical flasks by shaking a pre-weighed amount of the adsorbent with 100ml of the aqueous Copper solutions of known concentration and pH value. The metal solutions were agitated on a magnetic stirrer 120 rpm for a desired time. The samples were withdrawn from the stirrer at the pre determined time intervals and adsorbent was separated by filtration. Copper concentration in the filtrate was estimated using AAS. The experiments were carried out by varying the copper concentration in the solution (5-20 ppm), pH (2-5). The adsorbent dosage 0.5-2 gm/100ml for contact time are (30 – 120 mins). The samples were collected at different time intervals 30 min to 2 hrs and the adsorbent was separated by filtered using filter paper.

**% removal of copper = (C initial – C final) × 100/ C initial**

Where C initial and C final are the initial and final copper concentrations, respectively.

Batch experiment for copper Spectrophotometer adsorption.

## IV. RESULTS AND DISCUSSION

**Effect of pH:**

In this experiment pH vary between 2-5. As pH increases % removal increases. Maximum removal of copper is obtained at pH 5 after that it will decrease slightly, hence removal is 96.4%.

**Effect of dosage:**

In this experiment dosage vary between 0.25 – 1.0 gm per 100 ml. As dosage increases % removal increases, hence removal is 94.6%

**Effect of contact time:**

In this experiment contact time vary between 30 – 120 min. As contact time increases % removal increases, hence removal is 95 %

**Effect of concentration:**

In this experiment concentration vary between 5 – 20 ppm. As concentration increases % removal decreases, hence removal is 93.7%

**CONCLUSION**

Pollution control board has very strict rules for the effluents which are leaving in the industries, because some of the constituents of these effluents are the harmful. They cause effect on human beings and leaving organisms. Also effluent causes poisoning of agro lands and natural water sources like river, ponds etc. This project serves better for Cu removal, because sugarcane bagasse is easily available & they can reduce the expensive uses chemical, machineries for removal of heavy metal from industrial waste. From the above results we can say that the removal of copper ($Cu^{2+}$) by activating sugarcane bagasse is satisfactory. The study indicated that adsorbent prepared from sugarcane bagasse could be used as an effective adsorbent material for the treatment of aqueous waste streams containing copper. The adsorption of Copper onto sugarcane bagasse is found to be time, concentration and pH dependent. So it can be varied as per the industrial requirement to achieve more removal of heavy metals.

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